

# DOE Better Buildings Alliance High-Efficiency RTU Specification

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## 1.0 General

This specification provides a description of rooftop unit (RTU) efficiency and functionality characteristics that align with the goals of DOE's Advanced RTU Campaign (ARC) for new or replacement installations. This specification covers commercial packaged air conditioning units with direct expansion (DX) cooling and either gas or electric heating and air-cooled heat pumps. This short-form specification that covers the key needs of an ARC RTU specification at a high level, presented in a straightforward manner (rather than in an official specification template). A summary table with the specifications for minimum high-level and improved performance is included at the end.

## 2.0 Performance

All units shall meet or exceed the efficiency levels of CEE Tier 2 performance specification (effective January 6, 2012)<sup>1</sup> using the following test methods:

- For units less than 65,000 Btu/h, the energy efficiency ratio (EER) or the seasonal energy efficiency ratio (SEER) when tested in accordance with ANSI/AHRI 210/240.
- For units greater or equal to 65,000 Btu/h, the EER or the integrated energy efficiency ratio (IEER) when tested in accordance with ANSI/AHRI 340/360.

It is recommended to use the SEER or IEER performance metrics for energy savings because they represent part load performance and are better indicators of annual performance than EER. EER is an important metric when considering the peak load impacts.

## 3.0 Fan Operation

Supply air fan shall be variable volume or have multi-stage operation with, at minimum, three speeds corresponding to the following operational modes: ventilation or fan-only; cooling at 50 percent of rated capacity; cooling at 100 percent of rated capacity. Fan speed(s) for heating mode(s) can match that for 100 percent cooling mode; alternatively, fan speed(s) for heating mode(s) can be specified as additional, independent speed(s). For ventilation or fan-only mode, the supply fan controls shall be able to reduce the airflow to no greater than the larger of: (1) 50% of the maximum fan speed; or (2) the volume of outdoor air required to meet the minimum ventilation requirement.

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<sup>1</sup> CEE Commercial Unitary AC and HP Specification, <http://library.cee1.org/content/cee-commercial-unitary-ac-and-hp-specification-0>

## 4.0 Control

- Unit shall have a stand-alone Direct Digital Control (DDC) based control system and be compatible with remote energy management control and diagnostic systems.
- DDC controller shall be compatible with external BACnet or LonWorks third party devices or networks.
- Unit shall be controlled via an energy management system (EMS) or by a programmable indoor thermostat of the adjustable type and capable of storing a seven day schedule that captures four daily operational modes (morning, day, evening, and night). The number of thermostat heating and cooling stages should accommodate the corresponding operational modes of the unit.

## 5.0 Economizers

- Air economizing shall be required according to criteria defined in ANSI/ASHRAE/IESNA Standard 90.1-2010; economizer implementation shall also meet other local requirements that are in addition to or more stringent than those defined in this standard (e.g., Title 24 for California).
- If economizer is not available, the OA damper shall be at minimum position (according to ventilation requirement) during occupied times and fully closed during unoccupied times.
- The economizing function shall be capable of actuating outdoor air intake up to 100% of AHRI rated flow.
- Integrated economizer operation is required; the unit shall be able to economize while also providing mechanical cooling if economizer can't fully satisfy the zone cooling load.
- If economizer is available, and the zone is in cooling mode, and no compressors are running, the OA damper shall modulate to achieve discharge air temperature control.

## 6.0 Outside Air Dampers

- Outdoor air dampers shall be able to fully close (switching to 100% recirculation mode) and maintain leakage rates per ANSI/ASHRAE/IESNA Standard 90.1-2010.
- Outside air dampers must be able to respond to schedule-based occupancy signals (from the EMS or programmable thermostat) to facilitate demand control ventilation.
- To accommodate multi- or variable-speed fan operation, outside air dampers must be able to respond to fan speed signals (from the BMS or unit itself) to ensure that ventilation requirements are met in reduced fan speed modes.

## 7.0 Sizing

- Unit shall be sized according to the guidelines in ACCA Design Manual CS, Commercial Application, Systems, and Equipment.
- Approved design load calculation methods are provided in ANSI/ASHRAE/ACCA Standard 183, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.

## 8.0 Quality Installation

Unit shall be installed according to the guidelines in ANSI/ACCA 5 QI, HVAC Quality Installation Specification.

## 9.0 Quality Maintenance

Unit shall be maintained according to the guidelines in ANSI/ASHRAE/ACCA Standard 180, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems.

**High-Efficiency RTU Specification Summary**

Parameter	Minimum Specification	Improved Performance
Cooling performance	Performance meets or exceeds the CEE Tier 2 performance specification	Exceed CEE Tier 2: <ul style="list-style-type: none"><li>- SEER &gt; 18</li><li>- IEER &gt; 15</li></ul> RTU Challenge specification <ul style="list-style-type: none"><li>- IEER ≥ 18</li></ul>
Heating performance	Gas furnace: <ul style="list-style-type: none"><li>- Thermal efficiency &gt; 80%</li></ul> Heat pump performance exceeds the CEE performance specification HSPF for units < 65,000Btu/h, Tier 2 COP for units ≥ 65,000Btu/h, Tier 1	Thermal efficiency ≥ 90% for DOAS applications in cold regions Add energy recovery ventilators in cold regions
Fan performance	Supply air (evaporator) fan overall efficiency > 60% Condenser fan overall efficiency > 50%	Fan motor efficiency > 70% Direct drive fans Backward curved fans for the condenser fan
Fan control algorithms	Multi-speed or variable speed control for the following RTU modes: <ul style="list-style-type: none"><li>▪ 100% cooling</li><li>▪ 50% or modulated cooling</li><li>▪ 100% heating</li><li>▪ 50% or modulated heating</li><li>▪ Ventilation only</li></ul>	See above
Controls	Direct Digital Control (DDC) compatible with BACnet or LonWorks Controlled by an energy management system or programmable thermostat with week day and week end programming and four daily operation modes	
Economizer	Required according to ANSI/ASHRAE/IESNA Standard 90.1-2010 and local code requirements Capable of actuating to 100% of the AHRI rated flow	

Outside Air damper	Outside air dampers shall: Fully close when in recirculation mode and maintain maximum leakage rates. Respond to modulating signals to facilitate demand controlled ventilation Accommodate variable speed fan control to ensure that ventilation requirements are met in reduced fan speed modes	
Sizing	Unit shall be sized according to the guidelines in ACCA Design Manual CS, Commercial Application, Systems, and Equipment Approved design load calculation methods are provided in ANSI/ASHRAE/ACCA Standard 183, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings	
Quality installation	Unit shall be installed according to the guidelines in ANSI/ACCA 5 QI, HVAC Quality Installation Specification	
Quality maintenance	Unit shall be maintained according to the guidelines in ANSI/ASHRAE/ACCA Standard 180, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems	
Other characteristics to consider		
Warranty		
Dehumidification		
Energy Recovery	Energy recovery is most effective in heating dominated climates on RTUs with an outside air requirement. Must have access to the exhaust from the building.	